

# MONTANA CLINICAL COMMUNICATION AND SURVEILLANCE REPORT



Montana Department of Public Health and Human Services  
Chronic Disease Prevention and Health Promotion Program  
Room C314, Cogswell Building - PO Box 202951  
Helena, Montana 59620-2951

**ISSUE: OCTOBER - DECEMBER 2009**

## PREDICTORS OF BLOOD GLUCOSE SCREENING AND PRE-DIABETES IN MONTANA ADULTS

### WHAT'S INSIDE

#### **Page 1-7**

Predictors of Blood Glucose Screening and  
Pre-diabetes in Montana Adults

#### **Page 7**

#### **Save the Date!**

- Heart Smart - Heart Healthy "Making The Connection", February 4-5
- 9th Annual Montana Cardiovascular Health Summit Conference, April 8-9
- Worksite Wellness Conference, April 26-27

## BACKGROUND

Pre-diabetes is a condition defined as having impaired fasting glucose (IFG; fasting glucose between 100 and 125 mg/dl), impaired glucose tolerance (IGT; 2-hour glucose between 140 and 199 mg/dl) or IFG and IGT.<sup>1</sup> These levels of blood glucose are elevated, but not high enough to support a diagnosis of diabetes. Data collected from the National Health and Nutrition Examination Survey (NHANES 2003-2006) indicate that at least 25% of adults over age 20 have pre-diabetes.<sup>2</sup> It is likely that 185,000 Montana adults have pre-diabetes.

About one-third of persons with pre-diabetes progress to diabetes.<sup>3</sup> However, those that do existed in a pre-diabetic state for an average of 4-7 years before being diagnosed with diabetes.<sup>3</sup> During this time, a person with pre-diabetes is already developing the macrovascular complications associated with diabetes (e.g. atherosclerosis) and losing beta-cell mass in the pancreas, such that at the time of diagnosis of diabetes, 50% of beta-cell mass has already been lost.

The Diabetes Prevention Program (DPP) demonstrated that lifestyle intervention is a highly effective strategy to reduce the incidence of type 2 diabetes in persons with IFG, IGT or both. Diabetes incidence within four years of the intervention was reduced by 58% in the lifestyle group and 31% in the metformin group

when compared to placebo.<sup>4</sup> Even ten years after the DPP intervention, the rates of diabetes diagnosis were reduced 34% for persons who received the lifestyle intervention and 18% for those who received metformin.<sup>5</sup>

The American Diabetes Association (ADA) recommends screening for pre-diabetes and diabetes in asymptomatic adults of any age who are overweight or obese (BMI > 25 kg/m<sup>2</sup>) and who have additional risk factors for diabetes (Table 1). In the absence of these risk factors, screening for pre-diabetes and diabetes should begin at age 45.<sup>6</sup>

## METHODS

The Behavioral Risk Factor Surveillance Survey (BRFSS) is conducted each year in all 50 states, the District of Columbia and in three US territories (Guam, Puerto Rico and the Virgin Islands) to assess the health status of the population. In 2008, approximately 6,800 Montanans participated in the BRFSS. Six percent had prevalent diabetes and were excluded from analyses. Survey participants were asked about screening for diabetes and pre-diabetes (“Have you had a test for high blood sugar or diabetes in the past three years?”) and whether they had pre-diabetes (“Have you ever been told by a doctor or other

**Table 1. Criteria for testing for pre-diabetes and diabetes in asymptomatic adults**

1. Testing should be considered in all adults who are overweight (BMI > 25 kg/m<sup>2</sup>\*) and have additional risk factors:
  - Physical inactivity
  - First-degree relative with diabetes
  - Members of high-risk ethnic population (e.g. Native American, African American, Latino, Asian American, Pacific Islander)
  - Women who delivered a baby weighing >9 lb or were diagnosed with gestational diabetes (GDM)
  - Hypertension (>140/90 mmHg or on therapy for hypertension)
  - HDL cholesterol level < 35 mg/dL and/or a triglyceride level >250 mg/dL
  - Women with polycystic ovarian syndrome (PCOS)
  - Impaired glucose tolerance (IGT) or impaired fasting glucose (IFG) on previous testing
  - Other clinical conditions associated with insulin resistance (e.g. severe obesity, acanthosis nigricans)
  - History of cardiovascular disease (CVD)
2. In the absence of the above criteria, testing for pre-diabetes and diabetes should begin at age 45 years.
3. If results are normal, testing should be repeated at least every 3rd year, with consideration of more frequent testing depending on initial results and risk status.

\* At-risk BMI may be lower in some ethnic groups

health professional that you have pre-diabetes or borderline diabetes?”). Data were analyzed using SAS for Windows (release 9.1; SAS Institute Inc., Cary, NC) and SUDAAN (release 10.0; Research Triangle Institute, Inc., Research Triangle Park, NC) statistical software programs. To take into account sample design, sample weights were used in the estimation process. Standard errors were calculated using Taylor series linearization. Multiple logistic regression analysis was used to assess independent predictors of receiving blood glucose screening in the past 3 years and being told pre-diabetes status by a health care professional.

## RESULTS

### Independent predictors of blood glucose screening

In 2008, 52% of Montana adults without a diagnosis of diabetes reported having their blood glucose screened in the past three years. Age, sex, marital status, BMI category, health insurance coverage, educational attainment, and reported physical activity were all independent predictors of reporting screening for diabetes (Table 2). Consistent with current recommendations, adults between 45 and 54 years of age were 58% more likely to have blood glucose screening and adults over age 55 were between 111% and 123% more likely to have blood glucose screening compared to adults under age 30. Women were 21% more likely than men to be screened. Adults that had ever been married/partnered were between 50% and 90% more likely to be screened for diabetes compared to those who had never been married. There was a strong dose response for increasing likelihood of being screened for diabetes with increasing levels of BMI; persons with Class III obesity were nearly 7 times more likely to be screened for diabetes compared to those of normal weight. Not surprisingly, those

who reported having health insurance coverage were more than 2 times more likely to report having been screened for diabetes in the past three years compared to those without health coverage. Those that reported no physical activity in the last 30 days were 25% less likely to be screened for diabetes or pre-diabetes than those who had been physically active. There was no difference in reported diabetes screening prevalence between whites and American Indians (data not shown).

### Independent predictors of reporting prevalent pre-diabetes

Five percent of Montana adults report being told they have pre-diabetes or borderline diabetes by a health care professional. In unadjusted analysis, 12% of Montana Indians reported being told they had pre-diabetes compared to 5% of whites. The percent of those being told they had pre-diabetes increased with increasing BMI: 5% of overweight adults, 9-11% of those with Class I or II obesity and 16% of those with Class III obesity reported being told (Table 3). In adjusted analysis, age, sex, BMI category, educational attainment, having ever been diagnosed with asthma, currently having a diagnosis of cardiovascular disease, smoking status and having a blood glucose screening for diabetes in the past 3 years were all independent predictors of being told to have pre-diabetes. People who reported having had screening for diabetes in the past 3 years were over 2 times more likely to report being told they had pre-diabetes. Persons over 65 years of age were 59% more likely to report being told they had pre-diabetes compared to persons less than 65 years of age. Women were 62% more likely to report being told they have pre-diabetes compared to men, though there is no difference in diabetes prevalence between the sexes. As with diabetes screening, persons with higher BMI had a higher prevalence of being told they had pre-diabetes.

**Table 2. Independent predictors of receiving blood glucose screening in the past 3 years, Montana, 2008.**

	Percent [95% CI]	Odds Ratio [95% CI]
<b>Age (years)</b>		
18-29	35 [29-41]	1.0 [Referent]
30-44	47 [44-51]	1.06 [0.77-1.46]
45-54	56 [53-60]	1.58 [1.15-2.16]
55-64	65 [62-68]	2.23 [1.63-3.07]
65+	64 [61-67]	2.11 [1.53-2.91]
<b>Sex</b>		
Male	50 [47-53]	1.0 [Referent]
Female	54 [52-57]	1.21 [1.03-1.42]
<b>Marital status</b>		
Married/Partnered	55 [52-57]	1.51 [1.08-2.10]
Divorced/Separated	58 [54-62]	1.95 [1.33-2.86]
Widowed	64 [59-68]	1.70 [1.14-2.53]
Never Married	33 [27-39]	1.0 [Referent]
<b>BMI category (kg/m<sup>2</sup>)</b>		
Underweight (<18)	51 [35-66]	1.45 [0.67-3.14]
Normal weight (18-24.99)	45 [42-49]	1.0 [Referent]
Overweight (25-29.99)	53 [50-56]	1.33 [1.11-1.60]
Class I obese (30-34.99)	60 [55-65]	1.98 [1.55-2.53]
Class II obese (35-39.99)	61 [53-70]	2.22 [1.51-3.23]
Class III obese (40+)	81 [71-88]	6.93 [3.72-12.91]
<b>Health insurance coverage</b>		
Yes	57 [54-59]	2.25 [1.74-2.91]
No	32 [27-36]	1.0 [Referent]
<b>Education level</b>		
Less than high school	47 [39-54]	1.06 [0.75-1.49]
High school	46 [43-50]	1.0 [Referent]
Some college	51 [48-55]	1.14 [0.92-1.41]
College graduate	59 [56-62]	1.44 [1.18-1.77]
<b>Any exercise in the past 30 days</b>		
Yes	53 [51-55]	[Referent]
No	47 [44-51]	0.75 [0.62-0.90]

Those in BMI categories >30 kg/m<sup>2</sup> were 3.5-6.6 times more likely to report being told they have pre-diabetes compared to persons with normal BMI. Current smokers were 59% more likely to report being told they had pre-diabetes compared to non-smokers. Those who had ever been told they had asthma or cardiovascular disease (coronary heart disease, myocardial

infarction or stroke) were 85% and 58% more likely than those without those conditions to report being told they had pre-diabetes, respectively (Table 3). In adjusted analyses, Montana Indians were not more likely to report being told they had pre-diabetes compared to whites (data not shown).

## DISCUSSION

Our findings suggest that 61% of adults over 45 reported having their blood glucose screened in the past three years, significantly lower than screening prevalence in the US (67%).<sup>7</sup> Age, overweight and obesity, all risk factors for pre-diabetes and diabetes, were associated with higher reported screening prevalence. This

indicates that there is opportunity for Montana health care professionals to assess risk and screen where appropriate using national ADA criteria.

Overall, five-percent of Montana adults reported being told they had pre-diabetes; which was similar in the US (6%).<sup>7</sup> Using data from the NHANES survey, it is estimated that over 25% of US adults have blood glucose levels indicating

**Table 3. Independent predictors of being told to have pre-diabetes by a health care professional, Montana, 2008.**

	Percent [95% CI]	Odds Ratio [95% CI]
<b>Age (years)</b>		
<65	5 [4-6]	1.0 [Referent]
65+	8 [6-9]	1.59 [1.16-2.16]
<b>Sex</b>		
Male	4 [4-5]	1.0 [Referent]
Female	6 [5-8]	1.61 [1.16-2.24]
<b>Blood glucose test in the past 3 years</b>		
Yes	8 [7-9]	2.37 [1.65-3.42]
No	3 [2-4]	1.0 [Referent]
<b>BMI category (kg/m<sup>2</sup>)</b>		
Underweight (<18)		0.80 [0.18-3.58]
Normal weight (18-24.99)	3 [2-4]	1.0 [Referent]
Overweight (25-29.99)	5 [4-6]	1.87 [1.26-2.78]
Class I obese (30-34.99)	11 [8-15]	4.11 [2.56-6.60]
Class II obese (35-39.99)	9 [6-13]	3.47 [1.94-6.22]
Class III obese (40+)	16 [9-26]	6.60 [3.19-13.65]
<b>Ever told had asthma</b>		
Yes	9 [6-13]	1.85 [1.17-2.93]
No	5 [4-6]	1.0 [Referent]
<b>Prevalent cardiovascular disease</b>		
Yes	10 [7-13]	1.58 [1.03-2.43]
No	5 [4-6]	1.0 [Referent]
<b>Current smoker</b>		
Yes	7 [5-9]	1.59 [1.06-2.40]
No	5 [4-6]	1.0 [Referent]
<b>Education level</b>		
Less than high school	7 [4-10]	1.45 [0.81-2.60]
High school	4 [4-6]	1.0 [Referent]
Some college	8 [6-10]	1.85 [1.24-2.74]
College graduate	4 [3-5]	1.11 [0.75-1.64]

pre-diabetes. It is unlikely that the prevalence of pre-diabetes was lower in Montana; rather adults with pre-diabetes haven't been screened and/or were unaware of their condition. Women were more likely to report having pre-diabetes compared to men, though there is no gender difference in diabetes prevalence. This is probably due to greater personal health awareness and use of health care services in women rather than lower pre-diabetes prevalence in men. Those who had co-morbid conditions of asthma or cardiovascular disease, or who were smokers, were more likely to report being told they had pre-diabetes compared to persons without those conditions. While more frequent use of health care services by persons with one of these diagnoses may increase the chance of being screened and diagnosed with pre-diabetes, physiologic processes may underlie the increased risk a diagnosis as well. For example, chronic hyperglycemia characteristic of pre-diabetes accelerates the atherosclerotic process in blood vessels, leading to cardiovascular disease. A meta-analysis of 38 prospective studies on the association of blood glucose level and cardiovascular disease among persons without a diagnosis of diabetes found that those with the highest post-challenge glucose level were 27% more likely to have a significant cardiovascular disease endpoint compared to those with the lowest post-challenge glucose level.<sup>8</sup> Or, people with asthma commonly use steroids to control airway inflammation; steroid use can cause hyperglycemia, leading to a diagnosis of pre-diabetes or diabetes.<sup>9</sup> A case-control study of glucose tolerance in persons with and without asthma found that insulin resistance, IFG, and IGT were all more prevalent in persons with asthma compared to those without. And, chronic inflammation in persons with asthma may lead to higher prevalence of insulin resistance in these persons compared to those without asthma.<sup>10</sup> A recent prospective study found that current smokers were 2.4 times

more likely than never smokers to develop IFG.<sup>11</sup> Also, nicotine stimulates the release of epinephrine, which in turn stimulates catabolism of glycogen to glucose in the liver, raising blood glucose levels.

Fortunately, effective interventions exist to prevent or delay diabetes in persons with pre-diabetes. The anti-hyperglycemic agent metformin was associated with a 31% reduction in incident diabetes in the DPP clinical trial.<sup>5</sup> Intensive lifestyle intervention emphasizing modest weight loss and increased physical activity was associated with a 58% reduction in incident diabetes.<sup>5</sup> The Montana Cardiovascular Disease and Diabetes Prevention Program offers a similar lifestyle intervention for persons at risk for diabetes and cardiovascular disease using an adapted version of the DPP curriculum.<sup>12</sup> Sites in Missoula, Helena, Kalispell, Great Falls, Dillon, Billings and Miles City have been enrolling participants into a group prevention program since 2008. The 800+ participants who have been enrolled have been able to meet the 7% weight loss and 150 minute/week physical activity goals with same frequency as participants in the DPP clinical trial. For more information about this important prevention program, contact Diane Arave at 406-444-0593 or [darave@mt.gov](mailto:darave@mt.gov).

## REFERENCES

- <sup>1</sup> American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2008; 31; S1:S62-S67.
- <sup>2</sup> National Institute of Diabetes and Digestive and Kidney Diseases. National Diabetes Statistics, 2007 fact sheet. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, 2008.



<sup>3</sup> Ramlo-Halsted BA and Edelman SV. The natural history of type 2 diabetes: practical points to consider in developing prevention and treatment strategies. *Clinical Diabetes* 2000; 18; 2.

<sup>4</sup> Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346:393-403.

<sup>5</sup> Diabetes Prevention Program Research Group. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *The Lancet* 2009; Published online October 29, 2009. doi:10.1016/S0140-6736(09)61457-4.

<sup>6</sup> American Diabetes Association. Standards of medical care in diabetes - 2009. *Diabetes Care* 2008; 31; S1:S13-S61.

<sup>7</sup> Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2008.

<sup>8</sup> Levitan EB, Song Y, Ford ES, and Liu S. Is nondiabetic hyperglycemia a risk factor for cardiovascular disease? A meta-analysis of prospective studies. *Archives of Internal Medicine* 2004; 164; 19:2147-2155.

<sup>9</sup> Buchman, A. Side effects of corticosteroid therapy. *Journal of Clinical Gastroenterology* 2001; 33; 4:289-294.

<sup>10</sup> Gulcan E, Bulut I, Toker A, and Gulcan A. Evaluation of glucose tolerance status in Patients with asthma bronchiale. *Journal of Asthma* 2009; 46; 2:207-209.

<sup>11</sup> Ralfalson L et al. Cigarette smoking is associated with conversion from normoglycemia to impaired fasting glucose: The Western New York Health Study. *Annals of Epidemiology* 2009; 19; 6:365-371.

<sup>12</sup> Amundson et al. Translating the Diabetes Prevention Program into Practice in the general community: Findings from the Montana Cardiovascular Disease and Diabetes Prevention Program. *The Diabetes Educator* 2009; 35; 209.

## SAVE THE DATE

### HEART SMART - HEART HEALTHY "MAKING THE CONNECTION"

**FEBRUARY 4-5, 2010**

**Cody Hotel & Inn - Cody, Wyoming**

The Cardiovascular, Diabetes and Cancer Education Update Series will be held on Thursday and Friday, February 4<sup>th</sup> and 5<sup>th</sup>, 2010. For more information, contact Dian True at (307) 527-1947 or e-mail dtrue@billingsclinic.org.

### MONTANA CARDIOVASCULAR HEALTH SUMMIT

**APRIL 8-9, 2010**

**Hilton Garden Inn - Missoula, Montana**

The Cardiovascular Health Program's annual professional conference will be held on Friday, April 9<sup>th</sup>, 2010 in Missoula, Montana at the Hilton Garden Inn. This year, a pre-conference Hypertension Workshop will be held on Thursday, April 8<sup>th</sup>, 2010 at the same location. For more information, contact Crystelle Fogle at (406) 947-2344 or e-mail cfogle@mt.gov.

### WORKSITE WELLNESS CONFERENCE APRIL 26-27, 2010

**Holiday Inn - Bozeman, Montana**

For more information, contact Linda Krantz at (406) 444-4105 or email lkrantz@mt.gov.

## WHAT ARE THE MONTANA DIABETES PREVENTION AND CARDIOVASCULAR HEALTH PROGRAMS AND HOW CAN WE BE CONTACTED?

The Montana Diabetes Control and Cardiovascular Health Programs are funded through cooperative agreements with the Centers for Disease Control and Prevention and Health Promotion (1U58DP001977-01), the Division for Heart Disease and Stroke Prevention (5U50 DP000736-03) and through the Montana Department of Public Health and Human Services.

The mission of the Diabetes Control and Cardiovascular Health Programs is to reduce the burden of diabetes and cardiovascular disease among Montanans. Our web pages can be accessed at <http://www.diabetes.mt.gov> and <http://montanacardiovascular.state.mt.us>.

For further information please contact us at:

Section Manager <b>Mark Niebylski, PHD, MBA, MS</b> <a href="mailto:mniebylski@mt.gov">mniebylski@mt.gov</a>	CVH Program Manager <b>Crystelle Fogle, MS, MBA, RD</b> <a href="mailto:cfogle@mt.gov">cfogle@mt.gov</a>	Diabetes Program Manager <b>Karl Vanderwood, BS, MPH</b> <a href="mailto:kvanderwood@mt.gov">kvanderwood@mt.gov</a>	Quality Improvement Specialist, Cardiovascular Disease & Diabetes Prevention <b>Diane Arave, BS</b> <a href="mailto:darave2@mt.gov">darave2@mt.gov</a>
Epidemiologist - Diabetes <b>Taryn Hall, MPH</b> <a href="mailto:thall@mt.gov">thall@mt.gov</a>	Epidemiologist - CVH <b>Carrie Oser, MPH</b> <a href="mailto:coser@mt.gov">coser@mt.gov</a>	Diabetes Education Coordinator <b>Marci Butcher, RD, CDE</b> <a href="mailto:marcibutcher@msn.com">marcibutcher@msn.com</a>	
Quality Improvement Coordinator Diabetes Program <b>Chris Jacoby, BSN, RN</b> <a href="mailto:cjacoby@mt.gov">cjacoby@mt.gov</a>	Quality Improvement Coordinator Diabetes Program <b>Elisabeth Mann, RN, CDE, CPT</b> <a href="mailto:elsmann2@yahoo.com">elsmann2@yahoo.com</a>	Health Education Specialist <b>Linda Krantz</b> <a href="mailto:lkrantz@mt.gov">lkrantz@mt.gov</a>	
CVH Quality Improvement Coordinator <b>Marilyn McLaury, MS, RD</b> <a href="mailto:mmclaury@mt.gov">mmclaury@mt.gov</a>	CVH Secondary Prevention Specialist <b>Michael McNamara, MS</b> <a href="mailto:mmcnamara@mt.gov">mmcnamara@mt.gov</a>	OR YOU MAY CALL: Financial Specialist <b>Susan Day</b> Phone: 406-444-6677 <a href="mailto:sday@mt.gov">sday@mt.gov</a>	Financial Specialist <b>Ava Griffenberg</b> Phone: 406-444-5508 <a href="mailto:agriffenberg@mt.gov">agriffenberg@mt.gov</a>

The Montana Department of Public Health and Human Services attempts to provide reasonable accommodations for any known disability that may interfere with a person participating in any service, program or activity of the department. Alternative accessible formats of this document will be provided upon request. For more information, call (406) 444-6677 or TDD: 1 (800) 253-4091. 4,850 copies of this public document were published at an estimated cost of \$.25 per copy for a total cost of \$1,219.00 which includes \$1,219.00 for printing and \$.00 for distribution.

## MONTANA CLINICAL COMMUNICATION & SURVEILLANCE REPORT



Montana Department of Public Health and Human Services  
Chronic Disease Prevention and Health Promotion Program  
Room C314, Cogswell Building  
PO Box 202951  
Helena, Montana 59620-2951